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A COMPARISON OF AUTOMATED TEACHING PROGRAMS WITH CONVENTIONAL TEACHING METHODS AS APPLIED TO TEACHING MENTALLY RETARDED STUDENTS.

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TWO METHODS OF PRESENTING PROGRAMED MATERIAL AND THE EFFECTIVENESS OF THE INSTRUCTION ON MENTAL RETARDATE WERE STUDIED--(1) ANSWER-CONSTRUCT (A-C) WHICH REQUIRED THAT THE ANSWER BE WRITTEN-IN AND (2) MULTIPLE CHOICE (MC) WHICH REQUIRED THAT THE CORRECT ANSWER BE CHOSEN AND MARKED. THE SUBJECTS WERE 36 STUDENTS ATTENDING A STATE INSTITUTION FOR THE MENTALLY RETARDED. TWO EXPERIMENTAL GROUPS WERE DESIGNATED AND ASSIGNED. A THIRD GROUP (CONTROL) WAS ESTABLISHED TO RECEIVE CONVENTIONAL INSTRUCTION. THE SUBJECTS RECEIVED INSTRUCTION IN ARITHMETIC BY MEANS OF TEACHING MACHINES. PRE- AND POST-TESTS WERE ADMINISTERED AND THE RESULTS COMPARED. RESULTS INDICATED THAT (1) THE RETARDED CHILD DOES ADAPT TO PROGRAMED LEARNING AND APPEARS TO MAKE AS MUCH PROGRESS AS WITH CONVENTIONAL TEACHING, AND IN LESS TIME, (2) THERE WERE NO SIGNIFICANT DIFFERENCES BETWEEN GROUPS IN AMOUNT LEARNED IN THE SUBTRACTION COURSE WHERE THE MC METHOD RESULTED IN CONSIDERABLE IMPROVEMENT CONTRASTED WITH NO IMPROVEMENT IN THE AC OR CONVENTIONAL GROUPS. (RS)

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A Comparison of Automated Teaching Programs
with Conventional Teaching Methods as
Applied to Teaching Mentally Retarded Students¹

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The Partlow State School and Hospital

Teaching by machine has been described as a major breakthrough in education (Stolurrow, 1961). While published research in this area has been limited largely to work with that portion of the population whose measured intelligence falls at or above the sixteenth percentile, the present study explores the efficiency of automated teaching with students who are within the range of mental retardation.

Two methods of presenting the programmed material were investigated. The first, Answer-Construct (A-C), requires that the answer be constructed or written-in. The second, Multiple Choice (MC), requires that the correct answer be chosen and marked. Both procedures are of historical and practical interest. Pressey's (1926, 1927) early work on the development of machine teaching made exclusive use of the MC technique while Skinner (1958), who has been credited with reviving scientific and popular interest in automated teaching concepts, favors the A-C method. The design of the present study incorporated a comparison

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of the two automated methods with teaching by a conventional method. frames were essentially a repetition of the problems presented in the first 3,125 problem frames. A fading technique

Method

Subjects

Subjects were thirty-six students of both sexes attending the academic division of the Partlow State School and Hospital, a residential school for the mentally retarded. S's were divided into three groups and assigned a different teaching method. Groups were equated for CA, MA, IQ, and arithmetic achievement level. Table 1 gives these characteristics for each group. Not included are three S's who were dropped from the school rolls while the study was in progress.

Insert Table 1 about here

Program

The 12 factor table in addition and subtraction was used as subject matter. A search of the literature yielded no suitable program. Consequently, the construction of such a program became part of the research design. The resulting program consisted of a linear type presentation of 3,635 problem frames. The order of presentation was 59 frames of simple counting tasks, 1,107 frames concerned with addition, 629 frames of subtraction, 100 frames of discriminating correct arithmetical

The student answers the problem and then turns a roller advancing

signs, and 1,740 mixed addition and subtraction frames. These latter frames were essentially a repetition of the problems presented in the first 1,736 problem frames. A fading technique used for each problem accounts for the large number of frames. For the total program, the problems were grouped according to difficulty as defined by number of digits in the problem.

However, within these broad groupings the problems were randomly presented.

As the program was developed on an empirical basis, several prior forms were discarded when the trend from pre- to post-testing was not in the positive direction. The present program was accepted for the project after the first half was used with six adult mentally retarded subjects and there proved to be a trend toward learning as measured by the difference between pre- and post- test results. As the subjects were too few in number for proper validating procedures, the study represents a test of the program as well as a comparison of teaching methods.

Apparatus

The teaching machines used in the study were Ferster Tutors, designed and sold by Programmed Teaching Aids, Inc. This machine is a plastic covered, cardboard model which presents programed material on paper scrolls. The display panel is a rectangular slot, the upper half of which is covered with clear plastic. The problem appears in the uncovered lower half of the slot. The student answers the problem and then turns a roller advancing

the problem and his answer to a position under a plastic cover where it cannot be altered or changed. As this is done the correct answer moves to the lower half of the slot enabling him to check the accuracy of his response. Each student was assigned a machine and no difficulties were encountered concerning their manual operation. the second half of the preceding scroll. On the Tests

Two tests were developed to measure progress. They consisted of problems randomly selected from the program. Several more difficult problems were included to prevent the student from surpassing the limits of the test. Each test consisted of 43 addition and 24 subtraction problems. The same test was used for pre- and post- testing while the second set of problems was used for midterm testing. The method of administration required a verbal response given to a problem presented both verbally and visually by the examiner.

Procedure

S's assigned to machine groups were removed from classes for one half hour of programmed instruction in arithmetic. During this period the conventional teaching group remained in their classroom for instruction. Since the students learned to cheat the machines, a monitor was stationed in the area. Prior to beginning work on the machine, verbal and visual instructions were given describing its operation and the necessity of comparing the S's answer with the correct answer presented on the program.

Machine-taught S's started with the 59 problems of the counting scroll. As this was an easy task for the students, it enabled them to adapt to the method and machine before progressing to the more difficult arithmetic problems. The criterion to be met before progressing from one scroll to the next was not more than one error on the second half of the preceding scroll. On the average scroll this meant giving correct answers on 32 of 33 problems. After meeting this criterion on the counting scroll, the student proceeded with the addition problems. Upon completion of the 12 factor table in addition the subtraction problems were introduced. Completion of subtraction problems was the halfway mark of the program. S's were then presented two scrolls requiring the discrimination of the correct sign to a random selection of addition and subtraction problems. The second half of the program consisted of a random presentation of the addition and subtraction problems found in the first half.

S's were tested prior to the first teaching session, again at midterm, and at the end of the term. The amount of material to be covered was the same for the three groups. Since the normal rate of progress when teaching the 12 factor table in the classroom requires two semesters, the term intervals for the conventional teaching group were defined as follows: midterm was the week lying midway between the first and second semesters. End of the term was the last week of the second semester. For the machine group amount of material completed defined the term intervals.

Midterm was defined as completion of the sign scrolls and end of term as completion of the program or end of the time period allotted for the project, whichever came first.

Results and Discussion

A comparison of pre- and post- test results for each group, using the t test, revealed the following as summarized in Table 2: (a) both machine groups and conventional teaching showed significant improvement during the course of the addition program; (b) the MC machine method resulted in significant improvement during the course of the subtraction program; (c) no significant improvement occurred in the A-C machine or conventional teaching groups on subtraction problems.

Insert Table 2 about here

Under the conditions of the present study automated and conventional instruction are effective in teaching elementary addition to mentally retarded students. However, a multiple choice presentation of programmed subtraction problems is more effective than either an A-C program or conventional teaching. This conclusion considers only learning as measured by test results and not the amount of time spent in class. The conventional teaching group spent two semesters or 130 class periods studying arithmetic while the pupils in the two machine groups averaged 86 class periods. Therefore, when amount of time spent

working on the course work is considered, automated teaching would appear to hold a considerable overall advantage.

Generally, the present study suggests that automated teaching is a useful supplementary approach to teaching students who are mentally retarded. The retarded child does adapt to programmed learning and appears to make as much progress as with conventional teaching methods, and in less time.

1958.

Summary

Three methods of teaching principles of addition and subtraction were compared (two methods were presenting programmed material and the third was conventional teaching). A comparison of the difference between pre- vs. post- test scores indicated there were no significant differences between the groups regarding amount learned with the exception of subtraction as learned by the MC machine group. The two machine taught groups required considerably less time when compared with the conventional teaching group.

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Table 1

Characteristics of the Three Groups

Group	N	CA			MA			IQ		
		M	SD	Range	M	SD	Range	M	SD	Range
Answer-Construct	12	15-5	2-11	11-6 to 21-5	7-0	0-10	5-10 to 8-10	51	6.74	42 to 66
Multiple Choice	11	15-0	2-5	11-6 to 18-11	6-10	0-5	6-0 to 7-6	49	7.98	40 to 60
Conventional Teaching	10	14-10	2-3	11-5 to 18-4	6-8	0-8	5-6 to 7-10	49	4.82	42 to 59

Table 1 (contd.)

Group	N	Addition Achievement			Subtraction Achievement		
		M	SD	Range	M	SD	Range
Answer-Construct	12	12	8.96	2-31	3	3.48	0-12
Multiple Choice	11	10	6.77	0-22	4	3.81	0-11
Conventional Teaching	10	10	7.15	1-22	4	3.35	1-12

Means for three groups not significant at .05 level of confidence for all characteristics.

Table 2

Difference between Pre- and Post- test Scores for Each Group: t test

Group	Pretest Mean	Posttest Mean	df	t ratio
Answer-Construct				
Addition	11.92	17.42	11	2.29*
Subtraction	3.92	5.92	11	1.63
Multiple Choice				
Addition	10.18	18.64	10	2.65*
Subtraction	4.09	5.91	10	1.98*
Conventional Teaching				
Addition	10.20	17.00	9	2.13*
Subtraction	3.90	4.70	9	0.75

*Significant at the .05 point. One-tailed tests.